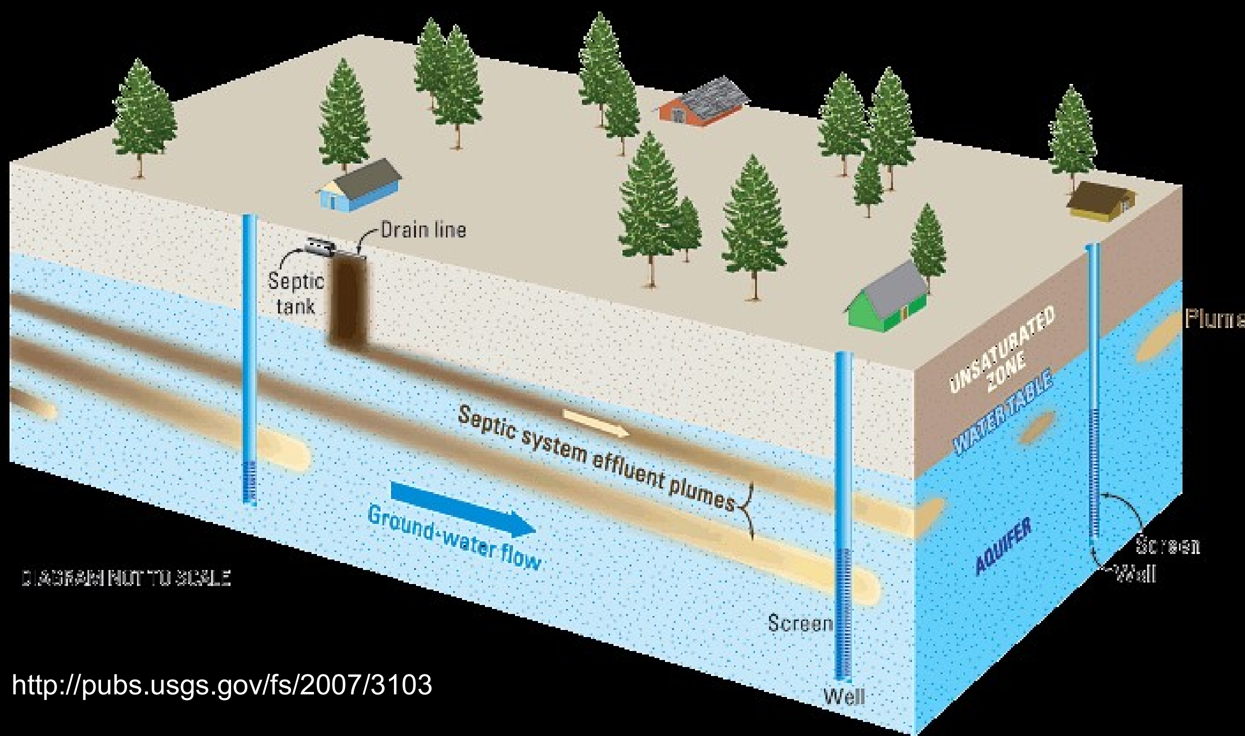
# SEPTIC SYSTEMS - DESIGN, CONSTRUCTION AND MAINTENANCE




http://pubs.usgs.gov/fs/2007/3103

## MANCHESTER TOWNSHIP ENVIRONMENTAL COMMISSION

### VIRTUAL PRESENTATION

June 23, 2020

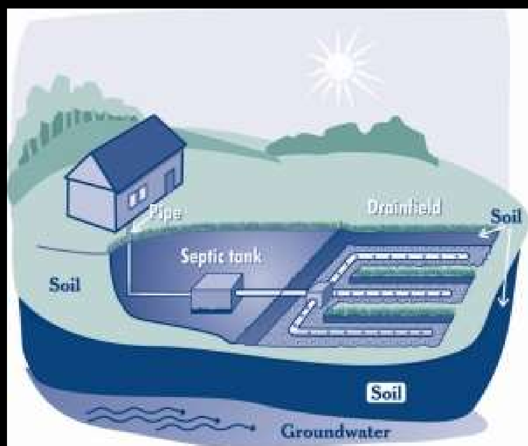
# Introduction to the New Jersey Pinelands
## A Nitrogen Sensitive Environment

# NJ Pinelands Facts

- Federal & State designation in 1978 & 1979
- Approximately one million acres – roughly 20% of NJ
- Protected via land use controls & environmental programs.
- Rare ecosystem characterized by low pH, nutrient-poor streams fed by shallow groundwater
- 17.7  trillion gallon Kirkwood-Cohansey aquifer system
- Habitat for 41 T&E animal species and 54 T&E plant species
- Headwaters to Atlantic and Delaware Basin Watersheds

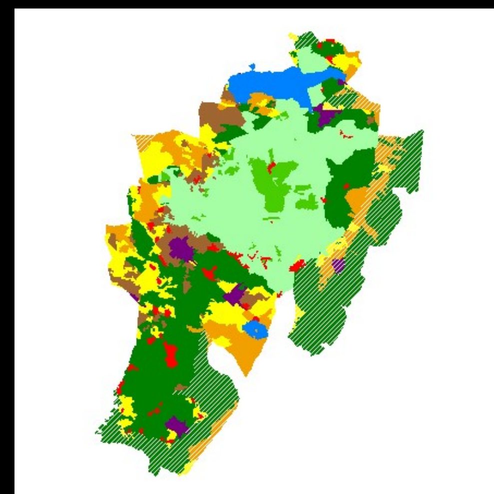
# Rules Governing Septic Systems in NJ & in the Pinelands

**STANDARDS FOR INDIVIDUAL SUBSURFACE SEWAGE DISPOSAL SYSTEMS**




New Jersey Department
Of Environmental
Protection
N.J.A.C 7:9A

**PINELANDS COMPREHENSIVE MANAGEMENT PLAN**



New Jersey
Pinelands Commission
N.J.A.C 7:50

# Rules Governing Septic Systems in NJ and in the Pinelands

New Jersey Department
Of Environmental
Protection
N.J.A.C 7:9A

Emphasis on treatment and isolation of wastewater pathogens for public health protection

New Jersey
Pinelands Commission
N.J.A.C 7:50

Emphasis on wastewater - borne nitrogen for ecological protection

# Human Pathogens in Wastewater

<u>Bacteria</u>

- Single cell organisms
- Prokaryotes (No membrane-bound nucleus)
- Reproduce via binary fission
- May be aerobic, anaerobic or facultative
- Typhoid, Salmonella, Shigella, Vibrio cholera

<u>Viruses</u>

- Protein outer shell (capsid)
- Interior contains either DNA or RNA
- Obligate intracellular parasites (need host in order to reproduce)
- Hepatitis A&E, Norovirus, Meningitis

<u>Protozoa</u>

- Single cell organisms – larger than bacteria
- Eukaryotes (Cells contain a membrane-bound nucleus)
- Most are aerobic, a few are anaerobic
- Giardia, Cryptosporidium, Entamoeba histolytica

<u>Helminths</u>

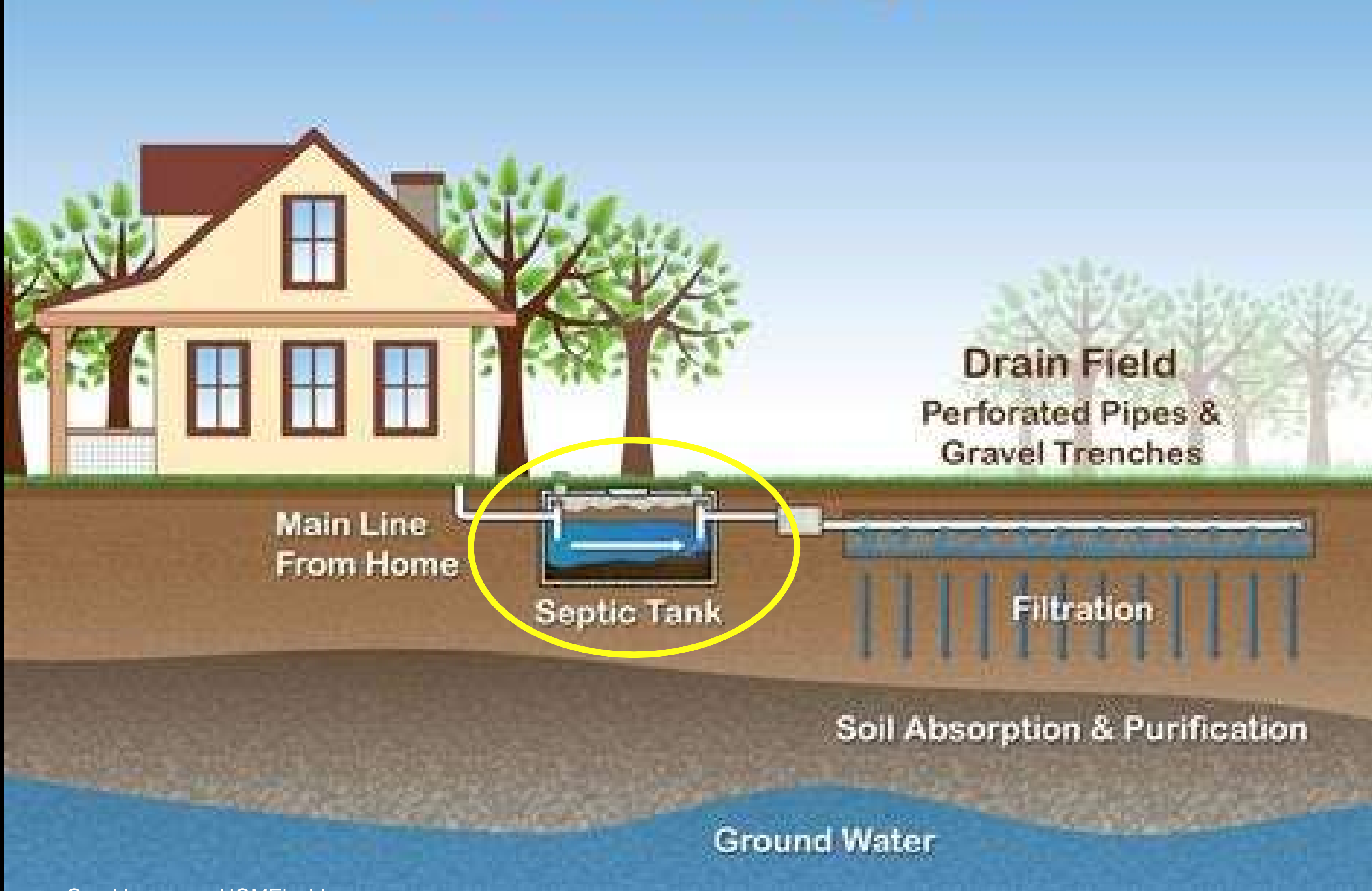
- Infectious in ova stage, not as free-living nematodes
- Tape, Hook and Round Worms

# Pathogen removal in wastewater treatment

- Chemical agents
  - Chlorine
  - Bromine
  - Iodine
  - Ozone

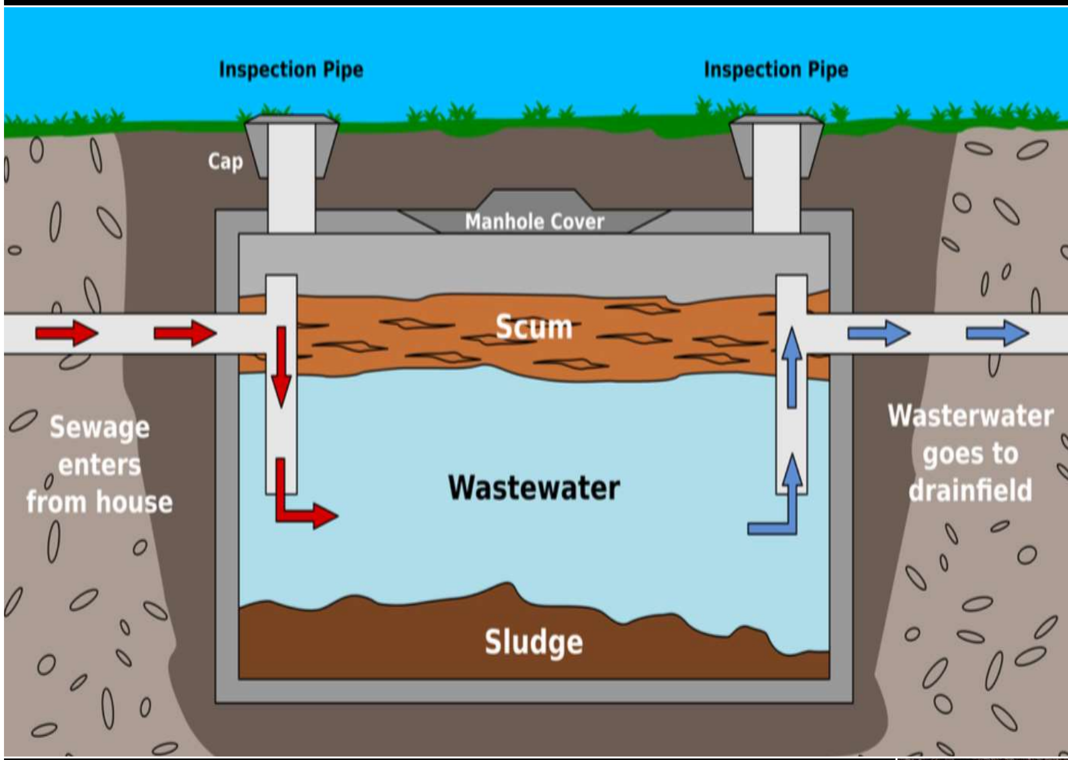
- Biological, physical & mechanical methods
  - Activated sludge – microbial predation
  - UV light
  - Heat
  - Desiccation
  - Filtration (membranes, sand filters and <u>soil</u>)

# Conventional Gravity Flow Septic System




Graphic source: HOMEinsider.org

# Typical single compartment septic tank



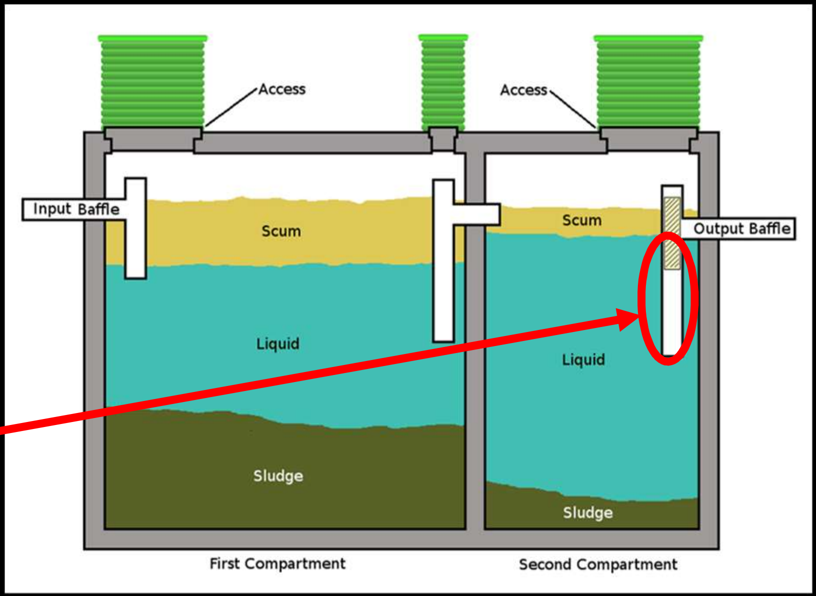

- Provides “primary treatment” of wastewater- solid/liquid separation
- Retains solids for anaerobic digestion
- Discharges relatively clear effluent to the drain field
- Size is based on number of bedrooms for residential systems


- 1000 gal minimum volume –up to 4 bedrooms. Additional 250 gal volume for each bedroom over 4.
- **Should be inspected / pumped every 3 years to remove accumulated solids (sludge)**
- “Septage” is taken to regional sewage treatment plants for treatment/disposal

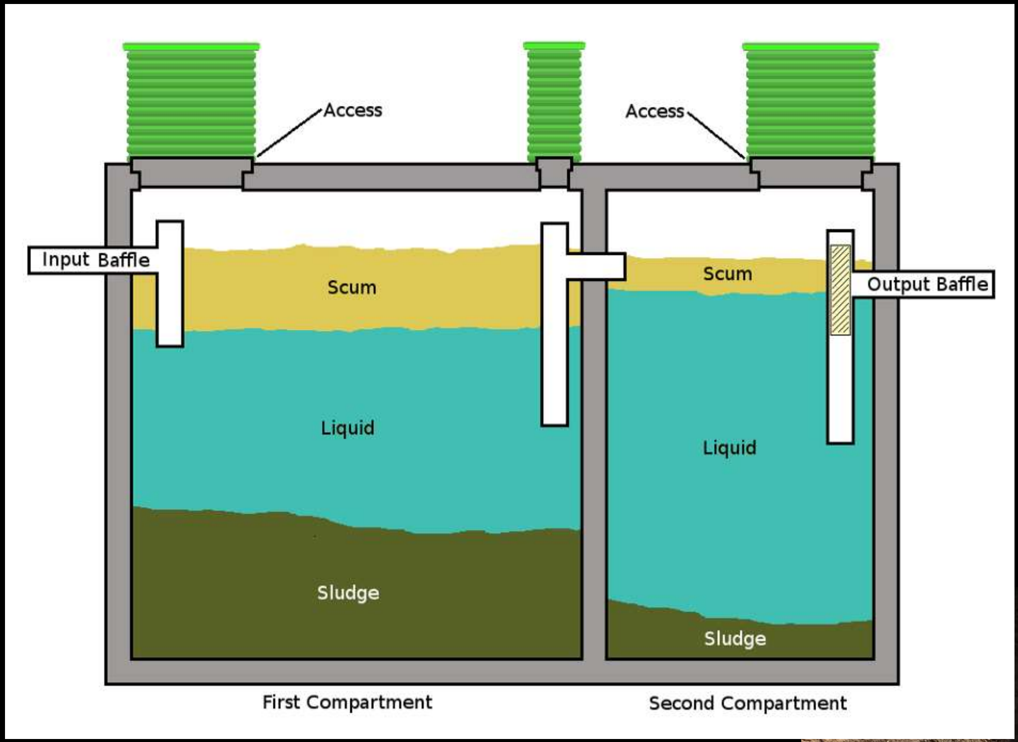
# Septic tank effluent filters

6" Septic Tank Outlet Baffle/Filter Combo
(includes 6" Outlet Baffle & Effluent Filter)


- Effective Feb 2012 - All septic tank outlets must be equipped with a **solids retainer or septic effluent filter** to prevent solids from clogging the drain field soils



# Typical two-compartment septic tank




- Provides better separation of solids and liquids
- Required if house is equipped with a garbage disposal/grinder
- Also required if a sewage ejector pump delivers sewage to the system.
- Important to have both compartments pumped


- Septic tanks may be precast concrete, poured in-place concrete, polyethylene or fiberglass.
- Septic tanks must be water-tight to prevent leakage in or out.
- Newly installed septic tanks must be fitted with locked or bolted manhole covers to prevent access by children.

# Septic Tank Abandonment

Tanks must be emptied (pumped) of wastes and filled completely with gravel, stone or soil and approved by the health department for all abandonments other than connection to a public sanitary sewer system .

If abandonment is due to the connection to a public sewer line, the tank abandonment must be approved by the local plumbing inspector.

(2/83 tragedy)

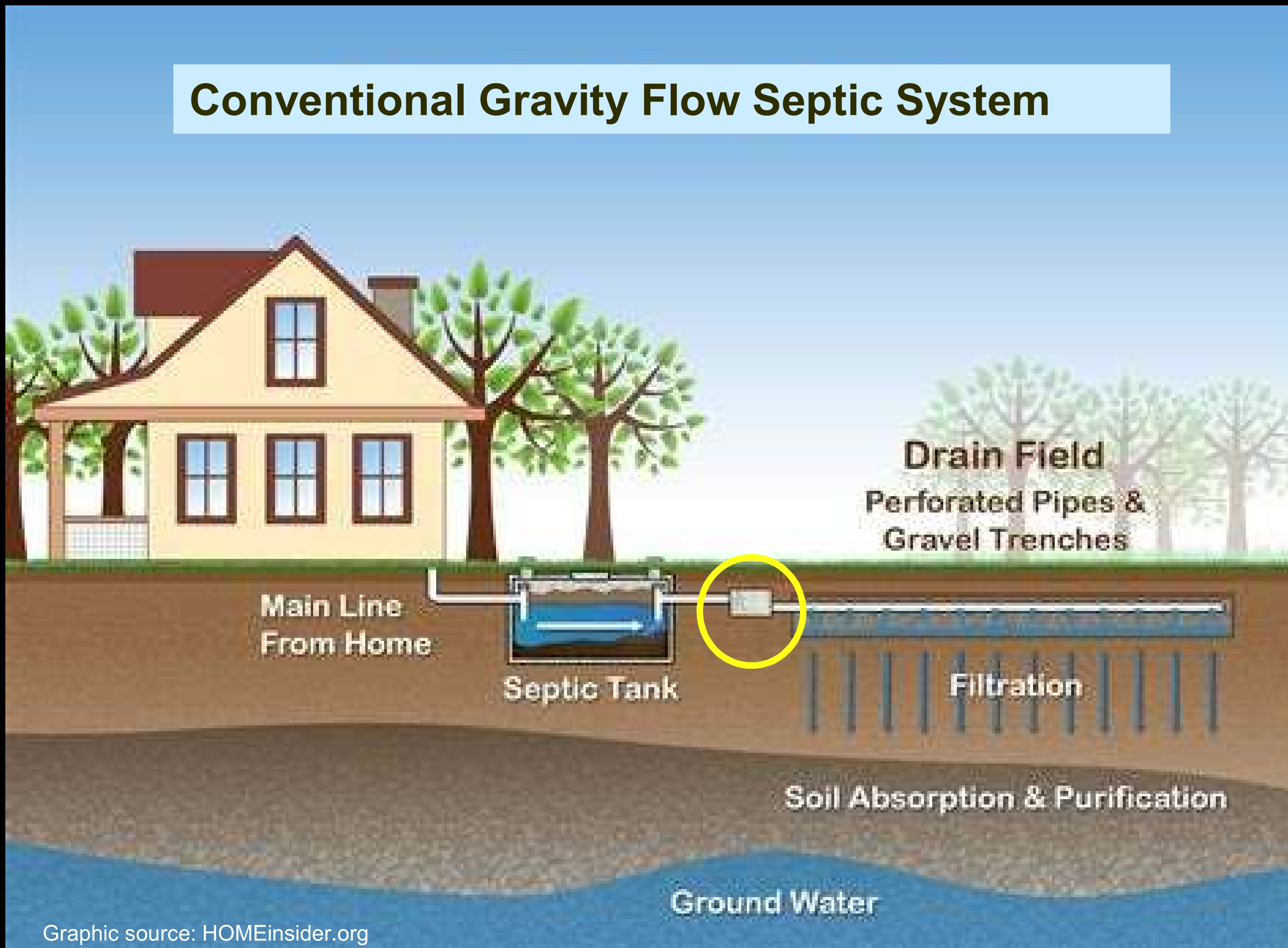
https://www.hydrogroup.us/septic_abandonments/

# Final comments on septic tanks


Special septic tank additives provide no benefit

Never dispose of pharmaceuticals, paint, solvents of other chemicals by dumping them down the drain

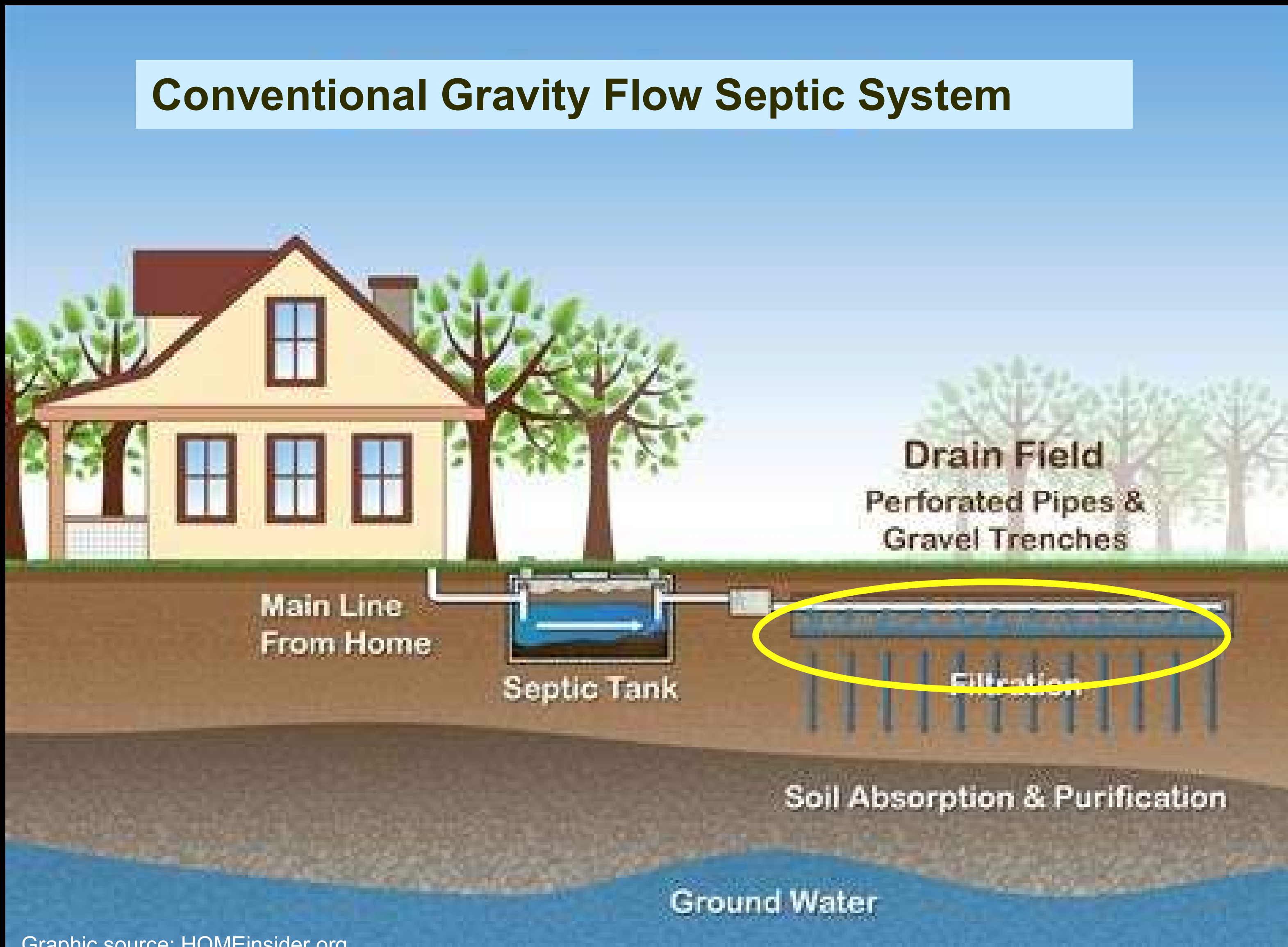
# Septic System Layout



# Distribution Box or D-Box

- Located between the septic tank and the effluent disposal field.
- Ensures equal volume of septic tank effluent flows to each lateral line in the disposal field
- Can be precast concrete, polyethylene or fiberglass
- Shallow – only about one foot below the ground  surface
- If damaged, can cause septic system to fail and allow wastewater to rise above the ground surface
- Inspection of the d-box can provide clues to how well the system was cared for

# Septic System Layout



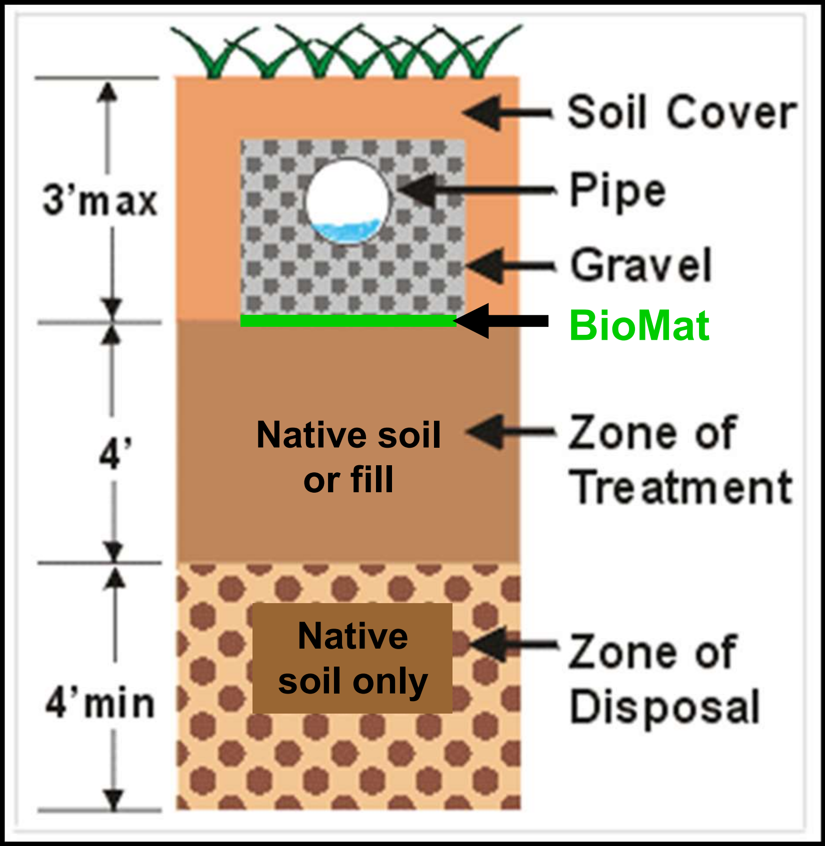

Graphic source: HOMEinsider.org

# Septic System Drain Fields

- Referred to  by many names: disposal field, disposal bed,  absorption field, absorption bed, septic bed, disposal bed, disposal area, disposal trenches, dispersal field, drainage field, etc.
- Typically consists of gravel and perforated pipe but may consist of gravel-less chambers
- Modern systems are shallow – no more than 3 feet deep to allow oxygen to penetrate

# Septic System Drain Fields

- Size of the disposal area is based on the volume of wastewater generated per day and the permeability of the soil underlying the field.
- Rapidly permeable soils and small wastewater volume = smaller field, slow permeability and larger wastewater volume = larger field.
- Modern systems are shallow – no more than 3 feet deep to allow oxygen to penetrate
- **A typical disposal field for a 4 bedroom residence is about 20' wide by 50' long or about 1000 square feet.**



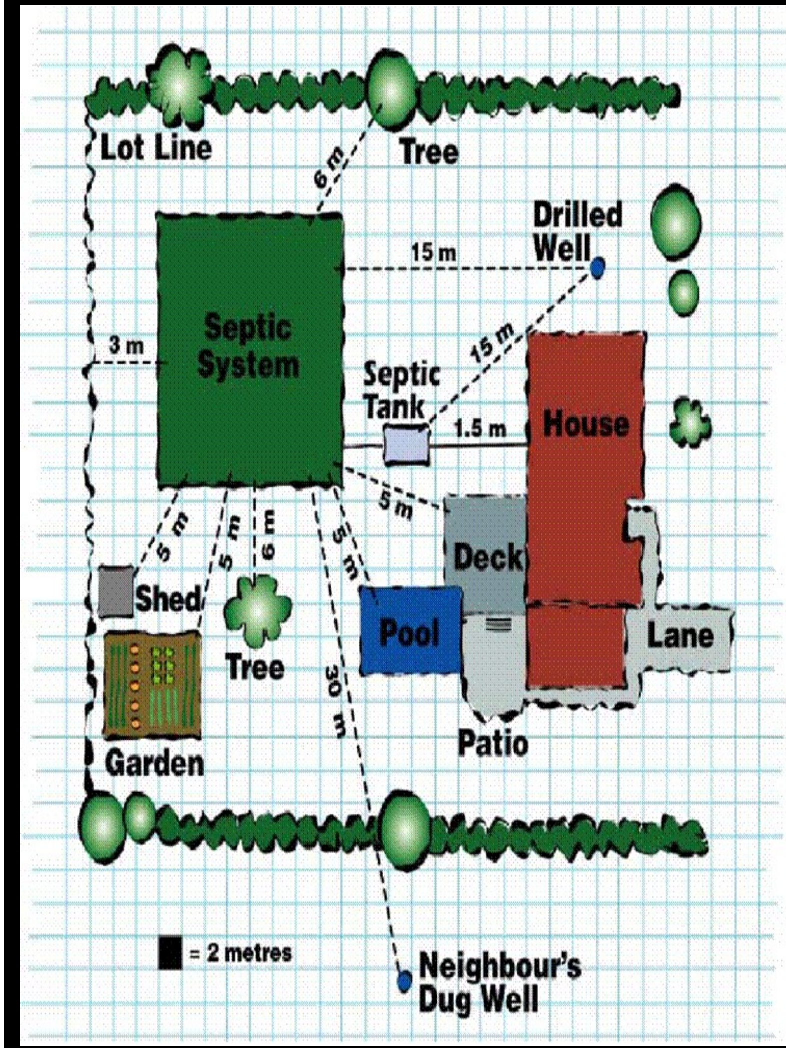

BioMat or Biological Clogging Mat

Wastewater solids, dead and living microorganisms, microbial secretions, insoluble compounds and non-degradable synthetic fibers.

3/16" to 1-3/8" thick with permeability on the order of 0.25 inches per hour

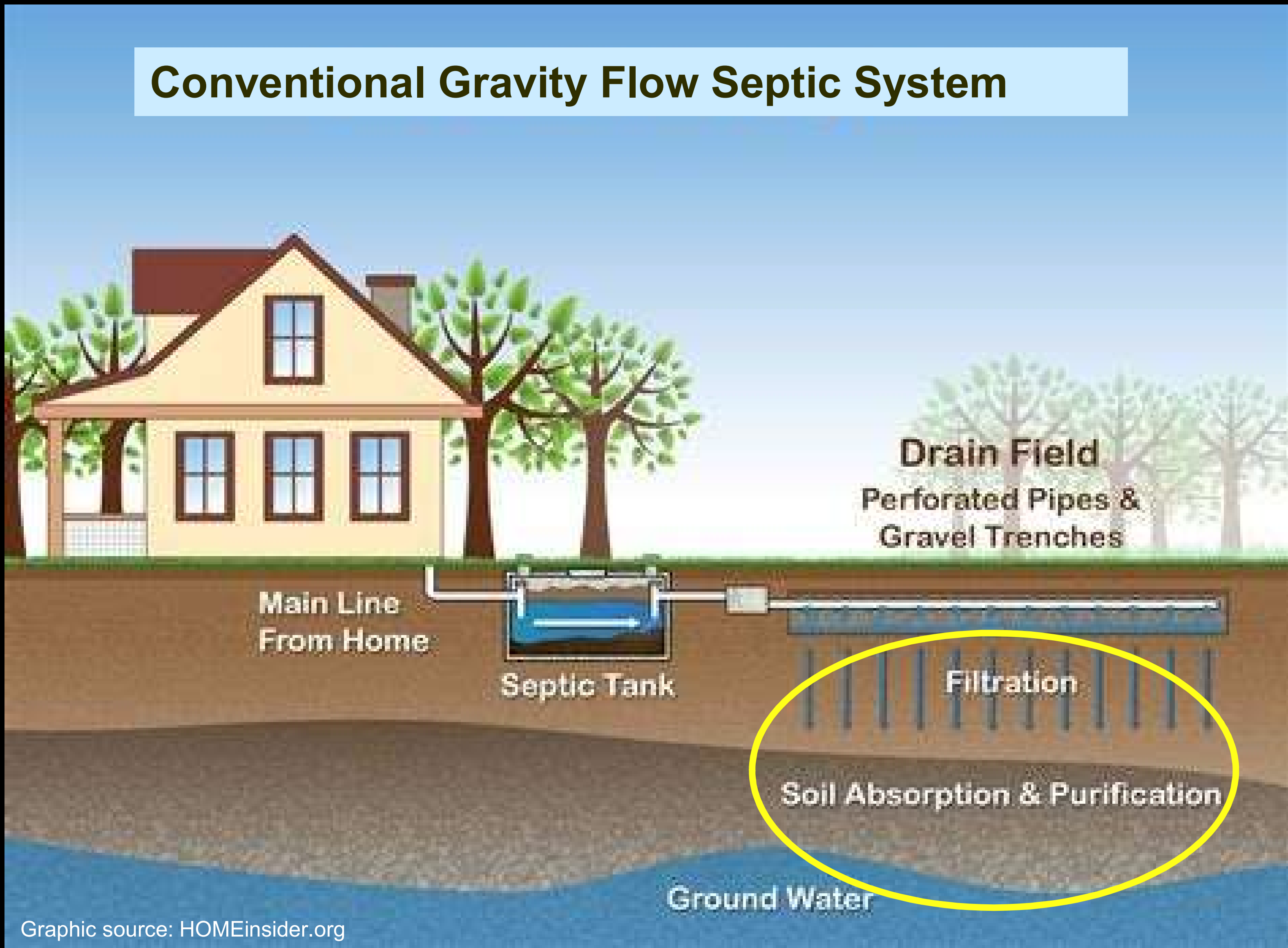
Removes organic material and pathogens from the wastewater

# Septic System Minimum Separation Distances




| Component | Property line | Occupied Bldg. | In-ground pool | Well |
|---|---|---|---|---|
| Septic Tank | 10’ | 10’ | 10’ | 50’ |
| Disposal Field | 10’ | 25’ | 20’ | 100’ |
| **Component** | **Water course** | **Disposal Field** | **Water service line (pressure)** | **Water service line (suction)** |
| Septic Tank | 25’ | N/A | 10’ | 100’ |
| Disposal Field | 50’ | 50’ | 10’ | 100’ |

# Septic System Layout



# “The Soil is the System”

Min. 2 Soil Test Pit Logs and Permeability Tests are required .

**Most important take-away from today’s discussion is the importance of onsite soil conditions.**

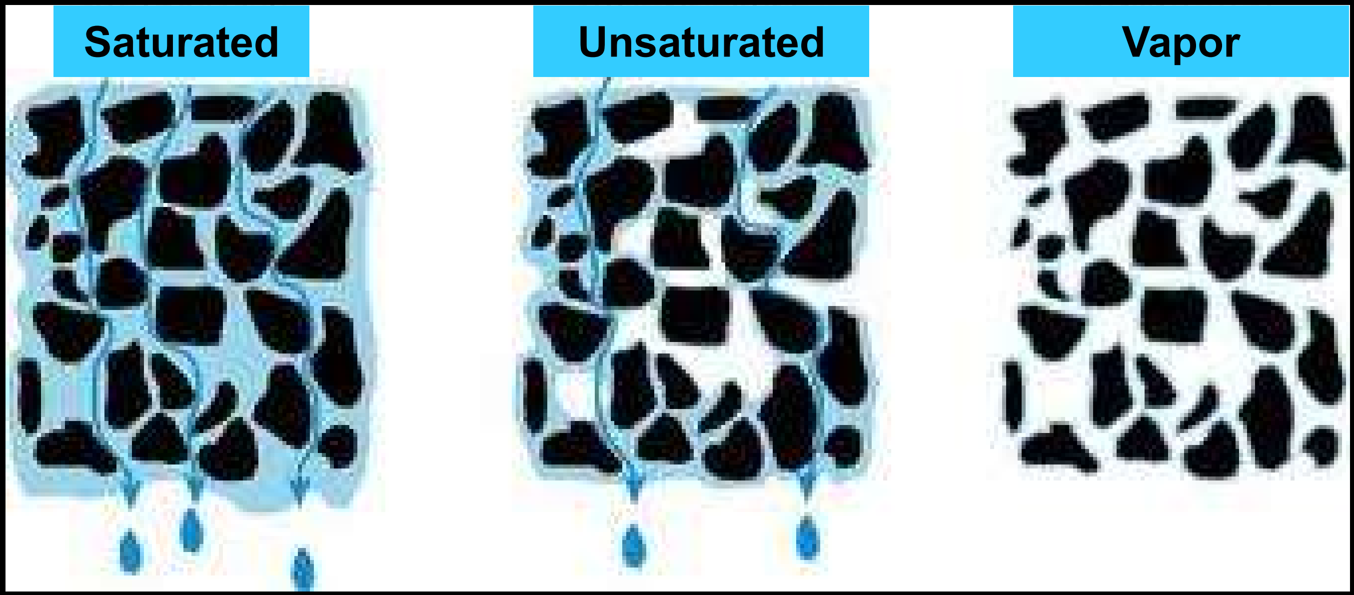
Designing and building the system: Septic Tank, D-Box and Gravel and Perforated Pipe is the easy part….Having suitable soil can be the hard part and a solution to poor permeability in the Zone of Disposal can’t simply be engineered .

For example:

If permeability in the Zone of Disposal is less than 0.2 inches/hour or the percolation rate is slower than 60 minutes/inch,  NJDEP’s rules do not permit a septic system to be approved or built.

Similarly, if the groundwater (SHWT) is less than 2 feet below the natural ground surface (5 feet in the Pinelands) a septic system cannot be approved or built.

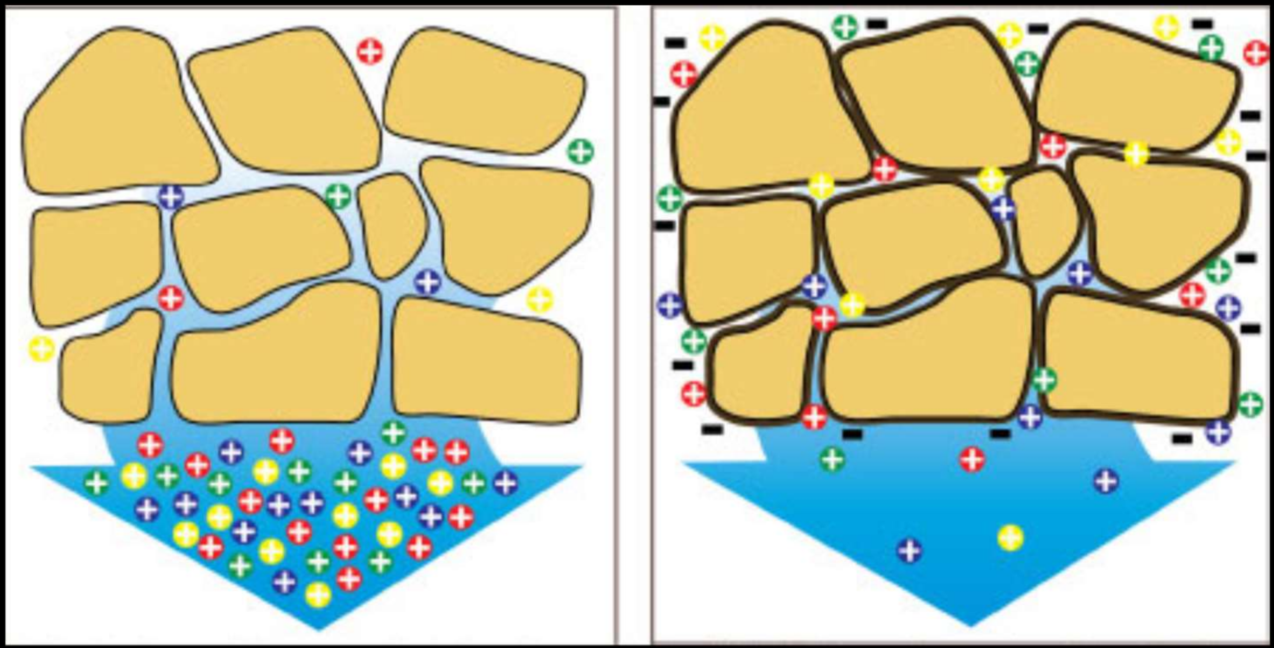
# Soil as a Treatment Medium




- Unsaturated flow increases travel time and maximizes contact with soil particle surfaces (via surface tension)
- Soil pores contain both air and water enabling aerobic microbes to treat the wastewater.

# Soil as a Treatment Medium

Cation Exchange – attraction and retention due to electric charge



Sandy soils with little to no charge (little clay or organics) can't retain pos. charged cation or neg. charged anion pollutants.

Neg. charge on loamy soils (clay and organics) attracts and retains positively charged cations (e.g ammonium, viruses , heavy metals, sodium, etc.) Neg. charged molecules (e.g. Nitrate) passes thru

Septic System Maintenance is as easy as having the septic tank pumped regularly…and doing it before there is a problem!

# A Historical Perspective from the 1800's

*In general, aquifers will return small quantities of untreated sewage to clean, pristine water fairly quickly. As long as the amount of sewage did not exceed the "assimilative capacity" of the underlying aquifer…"*

*But as the habitations were gradually built up and the population increased, it was noticed that the water in the wells, especially in the more populous portions, was rapidly losing its pristine purity, and was becoming hard, impotable and injurious to health…"*

Chapelle, 1997, p.162 discussing the correlation between increasing population (and privies) and the decline of water quality of wells in Charleston, South Carolina during the 1800's. From : Hoffman, J.L., and Canace, R.J., 2001, A Recharge-Based Nitrate-Dilution Model for New Jersey, NJ Geological Survey,

# Thank you!
# Questions?

**Ed Wengrowski, REHS**

**New Jersey Pinelands Commission**

**Environmental Technologies Coordinator**

**ed.wengrowski@pinelands.nj.gov**

**609-894-7300**